

RFID Supply Chain Management System for Naval Logistics

Final Report

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Nested Radio Frequency Identification
to Improve Supply Chain Management for Naval Logistics

915 MHz and 13.56 MHz

**Supporting Sea-basing and
the Maritime Pre-positioning Force of
the future (MPF-F)**



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Abstract for Nested Radio Frequency Identification to improve Supply Chain Management for Naval Logistics

The U.S. Navy is charged with the responsibility of providing a strategic Maritime Pre-positioning Force (MPF). To accomplish this objective the supply chain management system must be designed to allow for real-time accountability, Total Asset Visibility (TAV), rapid deployment and In-Transit Visibility (ITV). The proposed solution consists of a functioning Dynamic Smart Manifest (DSM) embodied in the structure of a Dynamic Smart Box (DSB). A middle-ware called Inteliware interfaces with the RFID components and computers in the DSB and inputs the requisite data into the Dynamic Smart Manifest. The DSB will be housed in a twenty-foot equivalent unit (TEU) which is the Navy's standard shipping container. The TEU will be outfitted with a system of open sourced RFID readers and antennae designed to read the tagged pallets and items that enter or exit the container. A nested architecture of passive/active tags and nested frequencies will create an aggregate inventory of the TEU's content. The ability to track and update inventory as pallets/containers are reconfigured will be demonstrated. The automation of the process of preparing the pallet/container data will result in the DSM, that will in real time provide the ability to sense and respond, count, record, identify, track and locate items, cartons, pallets and containers.

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1.0 General Background

1.1 MPF and Seabasing

As part of a global operational readiness, the Navy is charged with the responsibility of providing a strategic Maritime Pre-positioned Force (MPF). The MPF must be capable of supporting joint military operations among various branches of the United States' Armed Services and its Allies (NATO) throughout the world, without the necessity for a fixed port-of-call.

The Navy is currently designing new air and surface platforms to permit the build-up of a multi-modal sea-based logistics command capable of merging large amounts of material, equipment, ammunitions, pre-packaged service modules and other items required to sustain these forces. They must also be rapidly deployed.



Figure 1. An illustration of a seabasing operation

The logistics of this effort requires a system that can meld large numbers of troops with selective amounts of pre-positioned stores specifically set aside for that mission's objective. The sea-basing operation must package, store, re-assemble and merge the essential goods for a specified mission with the troops trained to carry out the specialized mission as called for by the combatant commander (COCOMs). After a mission is launched the sea-based logistics command must replenish and prepare for the next special operations mission. These stores must be versatile enough to accommodate small mission and then supply an entire battle group the next moment.. The MPF must be able to reconfigure to accept the requirements of different task-organized missions.

The sea-based logistics command will be required to manage the movement of goods from supplier-to-consolidation point, shore to ship, ship to ship, ship to shore and shore to inland theatres of operation. The Navy logisticians are going to have to create new Authorized Stockage Lists (ASL) to support the essential missions of the MPF. These ASL's will act like the warehousing function in a "just-in-time" supply environment. The ASL's will become the cargo manifest for the MPF. A shift from break-bulk carriers to containerized cargo will afford the MPF more control over cargo integrity, location, content and point of origin. It will reduce pilferage; speed up the handling of cargo at cross-docks, during in-transit transfers and unexpected layover.

Since the responsibility for most pre-positioned containers are relegated to the Military Sealift Command, as part of the joint service initiative of USTRANSCOM; most ships of the sea-base will be manned by civilian mariners from the U.S Civil Service, much like the Merchant Marine of World War II. Therefore, it makes sense to utilize standard shipping protocols and procedures familiar to the civilian mariner. It will also minimize redundancy of effort and improve economy of scale, if naval vessels are able to benefit from technology being developed for a wider user base.

Sea-basing will accomplish a rapid transformation of troops and materials in a very short period of time reducing the expeditionary forces response time from ten days to a matter of 24-48 hours during employment. It will allow sustainment forces and materials to arrive directly from CONUS, and will operate within 2000 nm of any advanced base, with the anticipated throughput capacity of 2000 short tons of materials per day. The sea-base will possess the ability to support operations 25-100nm off-shore while the expeditionary force engages the enemy on shore out as far as 240nm. The sea-base will be able to transfer 1500 short tons per day to forces engaged in high intensity operations ashore, thus eliminating the need for a fixed port and any associated force protection.

1.2 The Warehouse in Motion

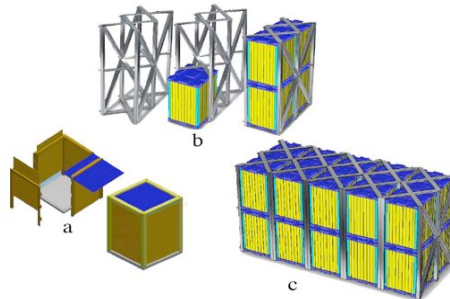
A new paradigm is being sought for the standard ISO shipping container or Twenty Foot Equivalent Unit (TEU). The ISO shipping container is the workhorse of the international cargo community, including the U.S. Navy. It is time to make the old ISO container into a more responsive shipping platform.



With expertise from Inteligistics, Inc. and the collaboration of their technology partners, the ISO container of tomorrow will be dynamic; it will be a secure package, storage, shipping, sensory and networking platform. The dynamic container will be smart; it will form a new paradigm for asset tracking, tamper detection, and secure access and interaction with existing business enterprise systems.

The ISO container will undergo a transformation that will start out with the pallet and ultimately create a seamless shipping system that utilizes an open off-the-shelf RFID architecture. It will

provide a flexible platform for new, emerging technologies. These technologies will allow the container to sense and respond to IT Systems miles away, creating a virtual “warehouse-in-motion”. The container will generate an electronic manifest of its content, a real-time running inventory, and update the manifests as the container’s content is deployed.



It will be possible to create an individual manifest for a build-out pallet as it is assembled from the aggregate containers using a wireless PDA equipped with a 13.56 MHz reader and antenna. The yardmaster will be able to tell where the container content is going, when and with whom as the content is build-out into deployed allotments.

Through this new paradigm, the Dynamic Smart Box, the Navy will ultimately be able to realize a practical demonstration and observe a future business case for use of nested RFID technology for future Naval Supply chain management applications.

2.0 Technical Background

2.1 Radio Frequency Identification and Frequency Nesting

RFID is a non-contact, proximity based, automatic identification and information technology that does not require manual scanning or line-of-sight. An RFID transponder (referred to as an “RFID tag” or “tag”), RFID interrogator (referred to as a “reader”) and attached antennas are the main components of any RFID system.

The tag is attached to the item it is identifying and communications occur via over-air protocols. The data is securely transmitted to central processing software or middleware. An RFID tag normally consists of a silicon chip (EEPROM) attached to an etched antenna.

There are two types of RFID tags, active and passive. Active tags are beacons that continuously broadcast a signal and require a battery power source. Passive tags do not need their own source of power, they use RF power from a near by reader. Passive tags, only able to communicate in an RF field and are interrogated by a reader. The Navy roadmap specifies the use of passive technology where applicable because the passive tags do not continually broadcast a signal, but relies on the signal of the interrogator to power their response.

There are multiple frequencies in which RFID can be used (e.g., 125 kHz low Frequency (LF), 13.56 MHz high frequency (HF), 433 MHz ultra high frequency (UHF), 915 MHz ultra high frequency and 2.4 GHz microwave frequency). The Department of Defense (DOD) has adopted 915MHz RFID as the standard passive technology of choice along with other commercial users like Wal-Mart.

Unfortunately, ultra high frequency standards are not compatible with other parts of the world. In North America the frequency standard UHF is 915 MHz, in Europe it is 860 MHz. Again, in China and Japan the UHF frequencies are completely different. To make the UHF tags universally operational, countries must adopt national and international standards (i.e. EPC Global and ISO Standards).

The best case for the use of 915MHz tags is their read range of up to 30 feet, but the tags have four major limitations. First, 915 MHz tags do not work well close to liquid or metal. Second, 915 MHz tags are hard to read in close proximity to each other. Third, because of their wide field, 915 MHz tags can produce false reads from outside the field of interest. Lastly, the tags are rather large and can not be placed on small objects for small item tracking. Therefore, it makes sense to only use the 915 MHz tags for tracking pallets, cases and large items (e.g. electric motors, pumps and engines). The large items will be tagged with what the DOD calls a Unique Identifier (UID).

HF, 13.56 MHz, RFID tags have a shorter read range, approximately 8-12 inches. Because a 13.56 MHz tag uses near field technology, it does not have the kind of interference problems associated with 915MHz. This allows HF tags to be read even though they may be in close proximity with each other. Another important characteristic of 13.56 MHz tag is its ability to be read while completely submerged in water. Because of its small size and the ability to be read in close proximity to another tag, it is the tag of choice for individual item tagging. It is in the process of being adopted as the RFID frequency of choice for tagging drugs by the Food and Drug Administration (FDA). It is also important to note the 13.56 MHz frequency can be used internationally without interfering with other communications devices in other countries.

It is important to understand that there isn't a single frequency can accomplish all of the tasks necessary to create a Dynamic Smart Box. A nesting of frequencies can track a container, account for its content, identify its content at the item level, and communicate the information via the internet to vital command centers. All this can be achieved by the use of an open architecture, commercial off-the-shelf technologies, and minimal fixed infrastructure. Although the Dynamic Smart Box will use 915 MHz and 13.56 MHz tags to create the Smart Box, the Smart Manifest and the Scratchpad, it should be noted that every effort will be taken to achieve compatibility with the current container tracking systems that use active tags at 433 MHz or battery assisted passive (BAP) tags operating at 2.4 GHz.

2.2 The Premise...iRISupply Cabinet

The iRISupply Cabinet is the premise for the Dynamic Smart Box and Manifest. It is a 13.56 MHz system that is currently in use in a number of major medical centers and has a proven history of success. More information about this product can be found at www.mobileaspects.com.

The iRISupply Cabinet is a secure controlled containment unit for holding multiple items using passive technology to track the cabinet's inventory in real time. iRISupply is unique because it utilizes RFID (radio frequency identification) technology to automatically determine whether the supplies are inside or outside of the cabinet. This eliminates the need for manual data entry, such as bar code scanning, button pushing, or note taking to track supply usage. All data is stored in a standard database to ease integration with existing information systems. Each cabinet can range from one to three compartments. The standard three interior compartments are approximately 28"x30"x22" each with its own door. When a compartment is accessed, the following steps will take place:

- After somebody logs onto the system the appropriate compartment doors are unlocked by the control processor when someone requests access to the cluster.
- Once access is granted, the doors will stay unlocked for a pre-configured period of time.
- The door can be opened to add or remove items from the compartment.
- After the door is closed, it will lock and the compartment will be scanned by the RFID reader to update the inventory of that compartment.
- Once scanning is complete, the control processor will update the inventory records and the user-access records in the database to reflect inventory changes and log the user accessing the system.
- Upon completion of the database updates the compartment door will be unlocked again.
- If no activity occurs within the cluster for a specified period of time all doors will be locked and the user will be logged out.



3.0 Technical Report

3.1 Mockup Construction.

We constructed a mockup to establish a baseline for read ranges and rates in a Radio Frequency-friendly environment. This doorway was built from 4"x4" lumber with the same inside dimensions as the doorway of a TEU. The actual dimensions used were 92.5" x 88.1875" (w x h respectively). Steel Uni-Strut was bolted to the frame to enable quicker and more accurate placement of the antennas during testing. Two photographs of the mockup are shown below in **figure 2**.



Figure 2. The Mockup

3.2 The RFID Equipment.

A ThingMagic Mercury IV RFID reader was used for both the mockup and the Smart Box (discussed in more detail in Section 4.0). This reader was chosen because it is easily upgradeable through its software based radio architecture. The ability to upgrade is necessary because the next generation of UHF tags (Gen2 class1) will be on the market late this year. We do not want the hardware to become obsolete in the middle of a possible phase II project. The reader is also programmable, permitting the user to program certain rules into it (e.g. when sensor A is activated the reader begins to read and when sensor B is activated the reader stops reading).

The antennas are Sensormatic's model IDANT20TNA25. These antennas are circular polarized. Circular polarization is less orientation dependent, which will help allow tags to be read no matter where they are placed on the pallets, cases or large items. The reader with one of the four antennas can be viewed in **figure 3**.



Figure 3. ThingMagic's Mercury4 Reader and antenna

Inteligistics has decided to evaluate tags from two different manufacturers, Alien and Symbol Technology. Two tags from each of the manufacturers are being tested. The tags from Alien are ALL-9238 and ALL-9254, which are both EPC1 tags. The tags from Symbol are "Pallet Label Tag" (EPC0) and "Generic Carton Label Tag" (EPC0+). These tags were selected to demonstrate that both protocols (EPC0 & EPC1) could be read at the same time with one system.

The computer connects to the Mercury IV using a web-based application. This application shows, in the results pane, from left to right the following information: 1) the order that the tag was read, 2) the number of times the tag was read, 3) the ID number, 4) the antenna that last read that tag, and 5) the protocol of that tag. This application is useful for testing the functionality of the tags, antennas and reader. We will be using the web-based application in the testing portion of this project. However, we have created our own simple computer program to do the inventory management for the demonstration in Phase I. A screen shot of the web-based application can be seen in **figure 4**.

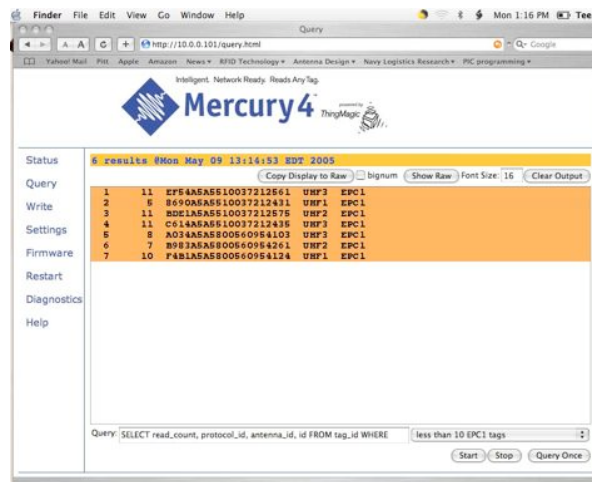


Figure 4. The Mercury IV web- based application.

3.3 The Procedure

We will track the following items: empty pallets, pallets with empty boxes, and finally pallets with content. The plan is to limit the number of unknown variables by introducing different complexities one at a time and documenting their effects.

3.4 Data Collection

The next important facet of this experiment is the orientation of the RFID tags on the pallet and cartons. **Figure 5** shows an example of how the cartons and tags could be oriented on a pallet. The picture is used to document the effects of tag placement. A picture like this will be printed without the black marks indicating the tag placement. The test engineer then places a mark on the box in the picture, where appropriate, to establish the location of the tag being tested. A scorecard is kept to show how many times each tag is read in that orientation.

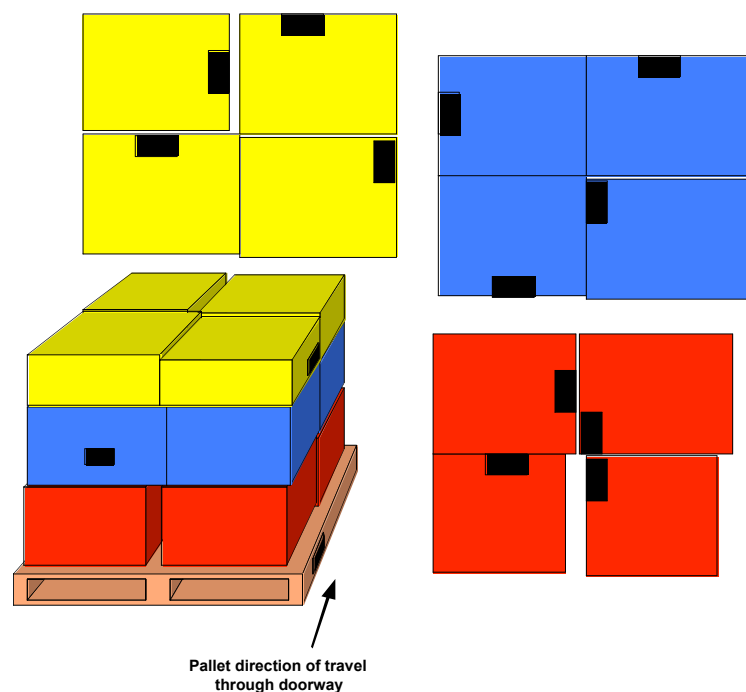


Figure 5. Placement of Tags and Cartons on a Pallet (Data Collection Sheet)

Figure 6 shows a pallet and cartons being read as they pass through the mockup doorway. The cartons, which are 20" x 10" x 10", and each level on the pallet contains six cartons.



Figure 6. Cartons and Pallet being read as they pass through the mockup doorway.

4.0 The Dynamic Smart Box

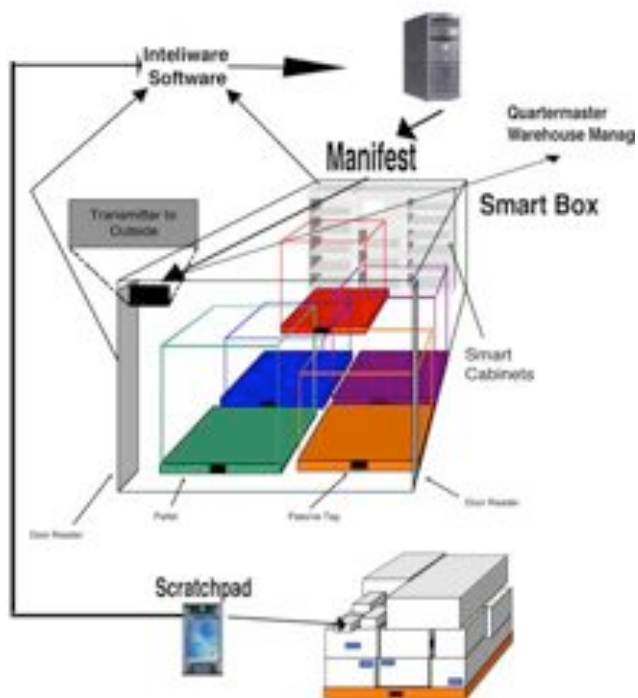


Figure 7. Functional Diagram of the Dynamic Smart Box

4.1 Frequency Nesting



Figure 8. How Frequency Nesting Works

4.2 Inteliware

Inteliware is an RFID middleware platform that can take input from all of the other components (from the fixed reader in the Smart Box, Scratchpad and/or the Smart Cabinet) to compile a Smart Manifest. The Inteliware is the glue that brings the components together and permits them to function as a complete supply chain management system. The system enables the Smart Box to track everything from large items, pallets and cases tagged with 915MHz tags all the way down to very small items tagged with 13.56MHz tags.

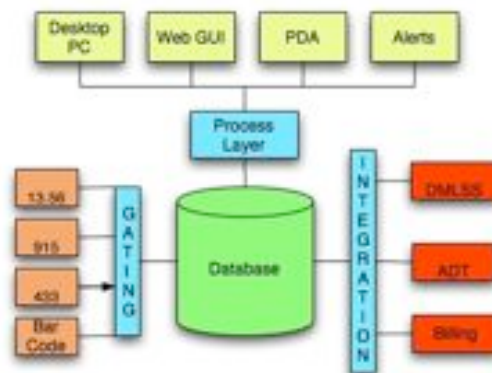


Figure 9. Functional Diagram of Inteliware

4.3 Phase I Demonstration of the Smart Box



Figure 10. Our First Smart Box

All of the equipment used in Phase I are commercial off-the-shelf (COTS) products.

Most of the work completed for the Smart Box in Phase I was figuring out the placement of the antennas inside of the container and what kind of scanning we would be doing. There are a few ways to scan cargo for a container.

One method is to use a portal reader, reading the tags as they pass through the doorway into the container. This method is good because it gives the RFID reader a chance to read the tag from multiple angles while it is moving through the RF energy field. The disadvantage of this method is that tags that might just be passing by the container can be read and it would be assumed that they were added to that container.

The other method is to use an area coverage method like the Smart Cabinets use. Since both the Cabinets and the shipping container have metal walls, this method can work for either one. With this method, the RF field can be contained by closing the doors so that only the items in the enclosed area are read. However, area coverage does not get a chance to read the tag from multiple angles because the tags are not moving. The placement of antennas for each of these methods is different.

The first method we tried was the portal reader. We placed the antennas in the doorway of the TEU and found that the tags were being read about 10 feet out in front of the container. This was not acceptable because we did not want to be reading tags on pallets that might just be passing by the front of the container. So we moved the antennas in 45" from the front of the container and we were still reading out in front of the container by about 6 feet. However, we found that we could read most of the tags in the container from this point. Since we could easily get the area coverage from this antenna placement, we decided to use the area coverage method.

The layout of the equipment for the Smart Box, as it was demonstrated in Phase I, is shown in **Figures 11 thru 15.**

4.4 The Smart Cabinet

The smart Cabinet is an RFID enabled, enclosed pallet sized structure that features access control that can be customized based upon preset business rules, certifications and can restrict access to specific compartments. It uses a smart card and PIN to authenticate the user and is rules based. The Smart Cabinet is capable of real-time inventory tracking of small items and utilizes 13.56 MHz.

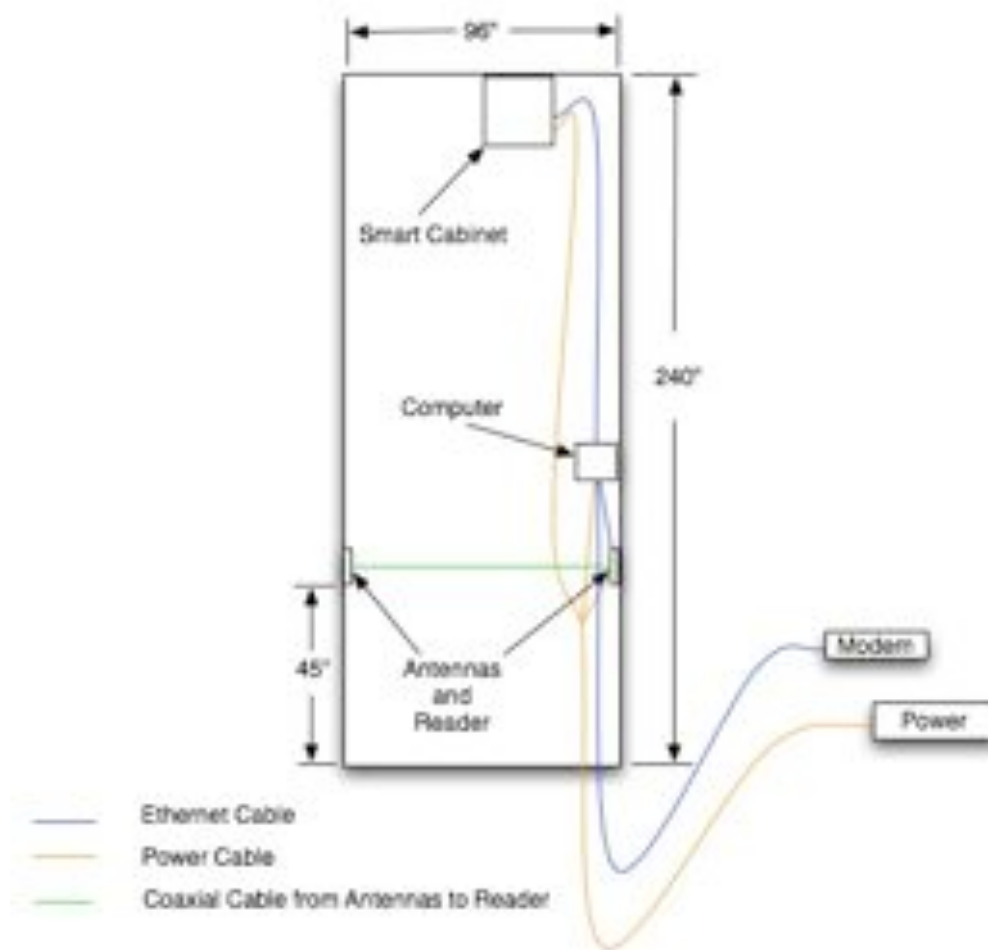


Figure 11. Smart Box with a Smart Cabinet installed. The Smart Cabinet can read items tagged at 13.56 MHz in real-time, but the Smart Cabinet is also tracked as a pallet with a passive 915 MHz pallet tag. Item content can be added or subtracted from the Smart Cabinet at random and still be traceable to a real-time cabinet inventory.



Figure 12. Empty ISO Container and pallets in staging area, bulk liquid, wood, plastic and collapsible pallets are all read with passive 915 MHz pallet tags. The cartons are also, tracked with 915 MHz passive tags.

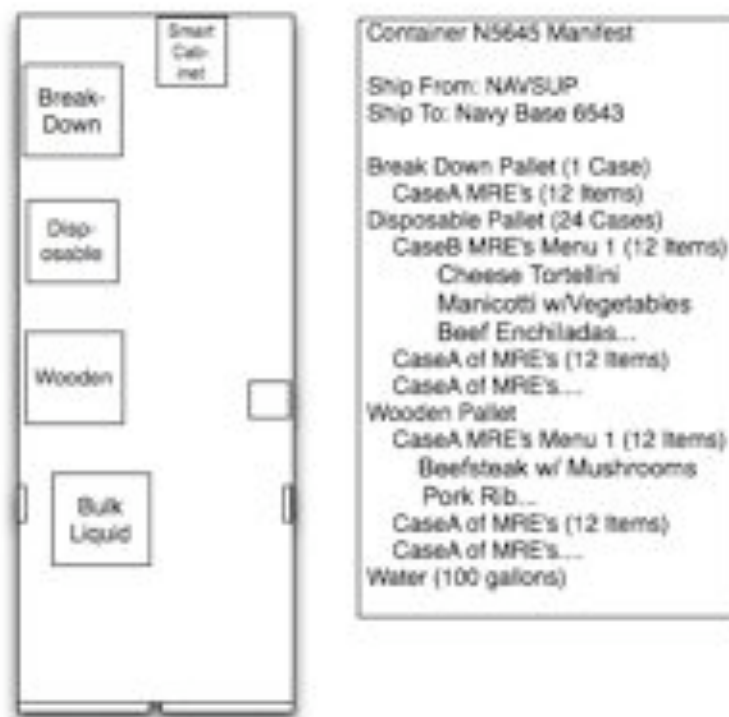


Figure 13. The Smart Box is loaded with standard pallets tagged with passive 915 MHz tags and a Smart Manifest is created when the doors are closed and the content is read.

4.4 The Scratchpad

The Scratchpad allows the tracking of small items as the items leave the Smart Box. Although items are tagged with 13.56 MHz passive tags, only the aggregate content of the pallets can be read by the cartons tagged with 915 MHz passive tags. A Hewlett Packard IPAQ 4700 was outfitted with a **13.56 reader and antenna card and** custom software was written for the Scratchpad that can interact with the Inteliware middleware to account for small items as they are being “selectively off-loaded” from standard 915 MHz tagged pallets for deployment.

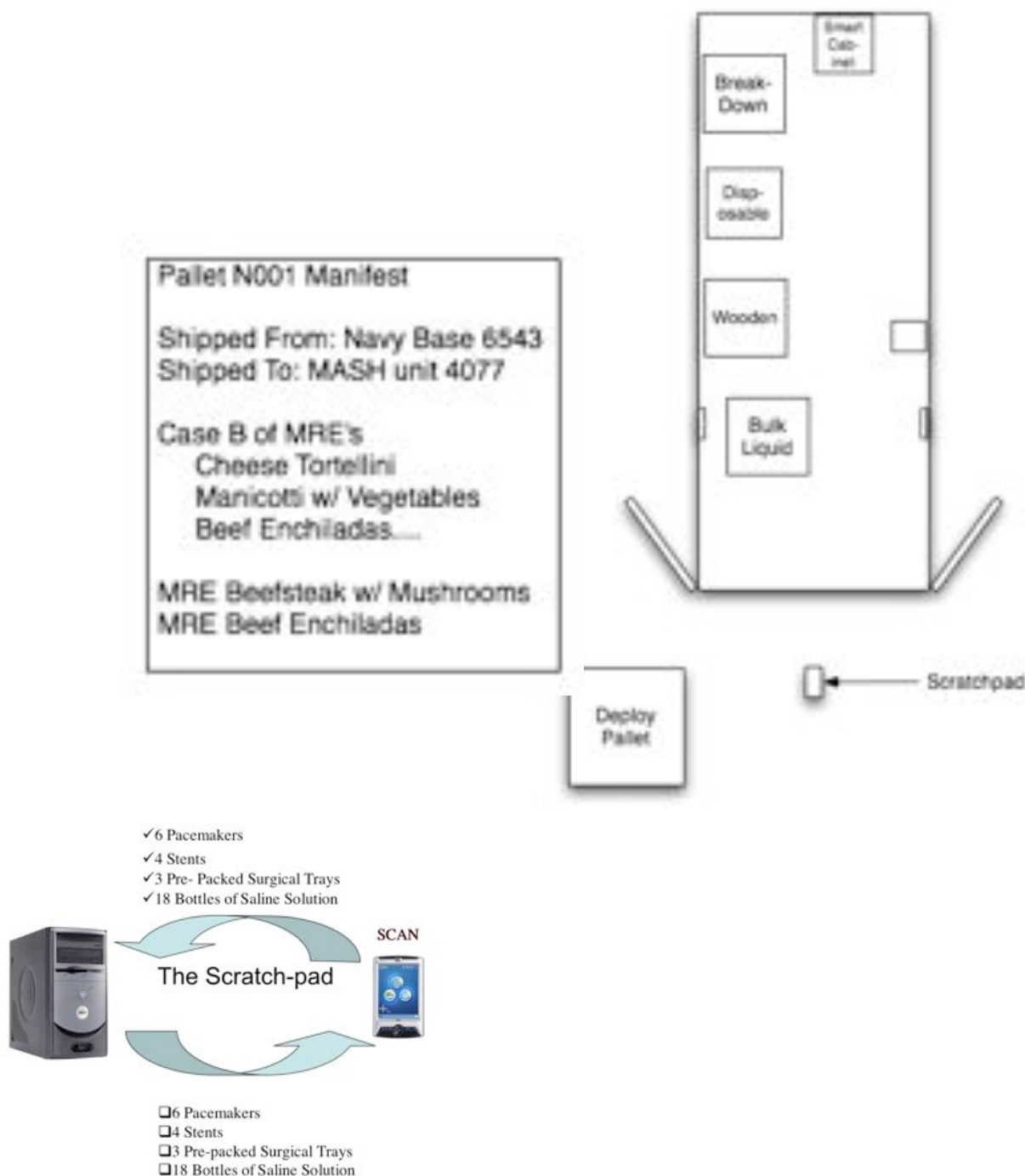


Figure 14. Doors open on the Smart Box and cargo is “selectively off-loaded” with the use of a Scratchpad. Item level content can be picked for placement on a deployment pallet, then the Scratchpad creates a deployed pallet manifest.

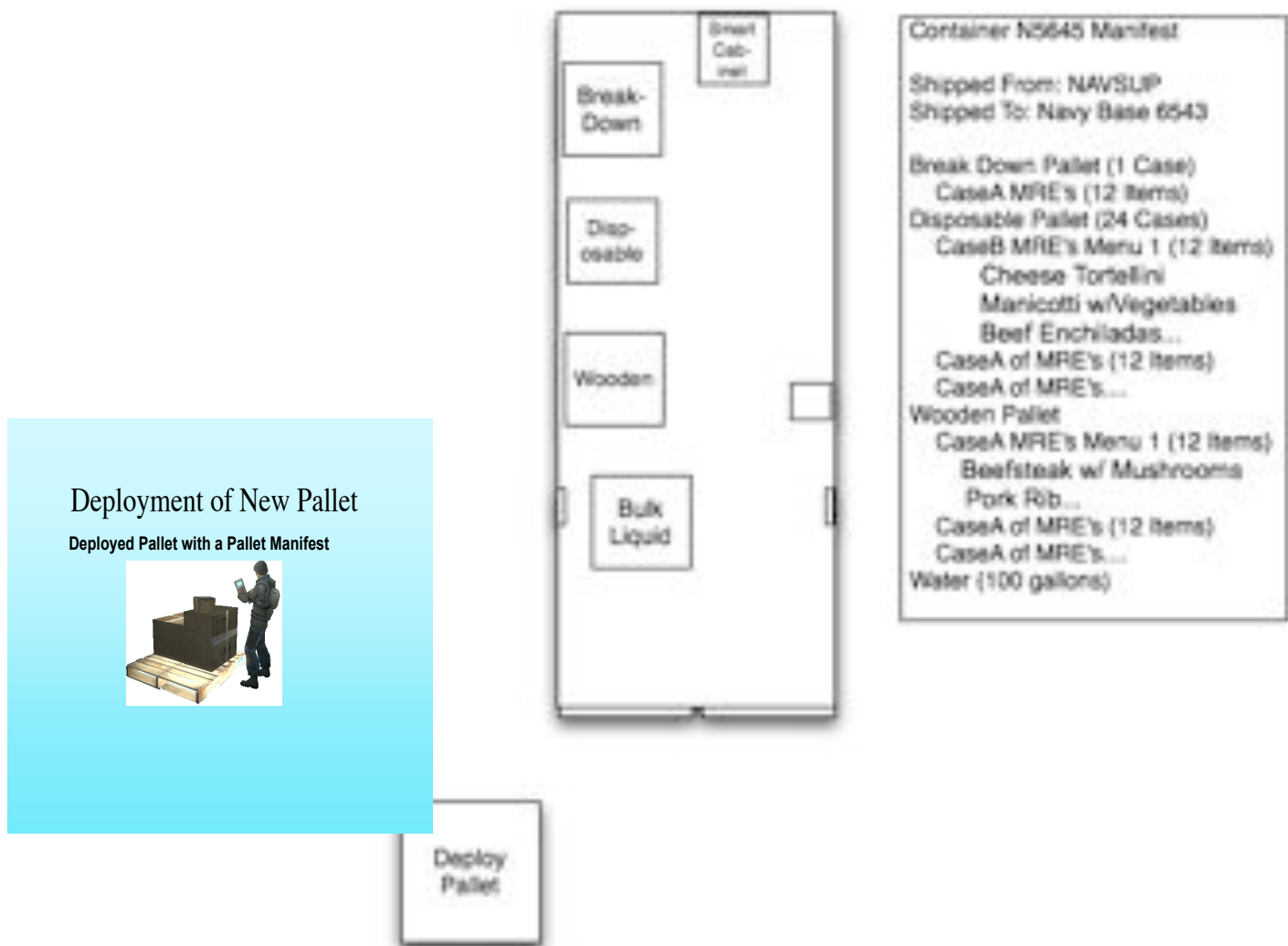


Figure 15. a) Doors close on the Smart Box and the container's content is reconciled to create a new updated Smart Manifest. b) The Deployment Pallet is sent to its destination.

4.5 Phase I Option

In the Phase I Option, a study will be made of the available active and battery-assisted-passive tags to select the most effective way to wirelessly communicate with the reader and interact with the Inteliware software in the Dynamic Smart Box. The study will include 433 MHz and 2.4 GHz technologies.

It will be important to know the amount of power, the source of the power, availability of the power and quality of the power as an ISO container makes its way through various choke-points and on shipboard. It will be necessary to examine the potential communications networks, their accessibility and costs. It will also be important to understand how NAVSUP and the Navy's Medical Logistics Command want to initially implement or deploy the Dynamic Smart Box.

4.6 Phase II

Phase II will start out by refining the accuracy, read rates and range of the reader/ antennae system to define the best area coverage within the standard metal ISO container. More in depth attention will be focused on the utilization of the PDA, specifically the HP-iPAQ, as a portable platform for individual supply chain management and container monitoring.

A complete robust design, development and testing program will be implemented for the Dynamic Smart Box and Dynamic Smart Manifest, which will include limited field testing. Efforts will be made to develop a light weight, modular system with little or no fixed infrastructure.

If the Navy is willing, an attempt to demonstrate under-way replenishment of a Dynamic Smart Box relative to in-transit visibility (ITV) and rapid deployment will be undertaken.

With our technology partners we will identify, test and evaluate the use of enabling technologies e.g. batteries, fuel cells, multi-frequency readers, RFID smart seals, real time location systems, and materials for light weight smart modular shipping containers as-well-as, explore the use of embedded environmental sensors and RFID.

5.0 Commercialization

Upon completion of Phase II, the Dynamic Smart Box[™], Dynamic Smart Manifest[™] and Inteliware[™] will provide the means to configure an intelligent logistics system. The system will literally provide the Navy with a "Warehouse in Motion" and the business community with "Smart Freight". The combined intelligent supply chain management system, IT interfaces and untethered (remote) design will provide a platform for a number of specialty applications.

The "Warehouse in Motion" will provide the Navy with the vehicle to launch "Total Asset Visibility" and provide real-time RFID supply chain management of goods in-transit. Repaired parts and components, Medical materials, Subsistence, Construction, fortification and barrier

material, Non-military program material and Clothing/individual equipment are some of the areas where the Navy's priorities for RFID Tagging and Total Asset visibility can be achieved.

The General Accounting Office (GAO report B-246015) states, "In the last war with Iraq, there were 40,000 containers shipped to the theater of operations. Of those, 25,000 containers were opened to determine contents since paper manifests were inaccurate or lost. The resulting misplaced and lost stuff resulted in losses totaling \$ 3 billion."

"Smart Freight" will appeal to companies that are interested in cargo security, timely and reliable movement of goods and expedited Customs clearance. It is estimated that over 12 million cargo containers enter the United States each year, and over 5% of all container movements in the world develop problems during transit. The containers are misrouted, stolen, damaged or excessively delayed as a result of human error or carelessness (Wall Street Journal, 1/05/04).

Inteligistics is in preliminary discussion with a Pittsburgh based multi-national corporation to address the problem of illegal diversion of pallets/containers of goods being shipped to international markets. These goods are returning to the United States and other countries on the "Black Market". The customer would like to track the pallets/containers via RFID tags and GPS. It is our intention to use the Dynamic Smart Box and Dynamic Smart Manifest to address the issue.

Pre-packaged service modules, such as, mobile aid stations, modules for complete field-hospitals, portable machine shops, communications command and control centers, and monitored storage units for hazardous materials are just some of the potential uses identified for the "Dynamic Smart Box" and "Dynamic Smart Manifest". Additional commercial applications will include engineering spare parts storage, documentation storage and construction lay down areas, where items are tracked in real time.

Strategic partnerships are important; Inteligistics wants to form alliances with industry partners who will lead by example: partners that recognize the value of RFID as a tool to improve their own internal supply chain management operations.

The Boeing Company has expressed an interest in the Dynamic Smart Box and Smart Manifest for untethered storage and service modules to improve the flexibility of their production facilities.

The Department of Defense, Wal-Mart and NATO, among others, are requiring suppliers to adopt RFID. IDC, IT analysts, expect spending for RFID technology in the retail industry to grow from \$91M in 2003 to almost \$1.3B by the year 2008 (Financial Times, 5/12/04).

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6.0 Enabling Technologies for Seabasing



Cooperative venture between Penn State University
and Secor and funded by the Office of Naval Research



Automated Storage and Retrieval System (ASRS)



Hi-Rate Vertical to Horizontal Transport

General Dynamics

Armament and Technical Products

Project funded by Office of Naval Research (ONR)

7.0 Technology Partners

Inteligistics has assembled a multi-talented staff, management and group of consultants from industry and academia. We have established strategic relationships with other technology companies and customers. Our technology partners include Dave Cannon of Seicor AutoLog™, Bayer MaterialSciences, Lanxess, Kema Powertest, The Boeing Company, Mobile Aspects, Supply Chain Management Group, and Texas Instruments. Additionally, H.J. Heinz, Siemens Dematic and The Boeing Company have expressed interest in supporting Inteligistics during the development of our current products and in commercializing the resulting technology.



In support of Inteligistics' effort to explore RFID tag tracking of containers and their contents, Seicor has proposed beta testing the Dynamic Smart Box, Dynamic Smart Manifest and Dynamic Smart Carton at the Navy's NFESC test site in Port Hueneme, CA. The site was developed to test new concepts in container handling utilizing Automated Logistics (AutoLog) technologies. The AutoLog technology is a joint development venture of Seicor and Penn State University. (Contact: Dave Cannon, david.cannon@navy.mil)

Bayer: Science For A Better Life



Bayer MaterialScience is leading supplier of engineering thermoplastics, thermoplastic urethanes and advanced composite plastics. Bayer's expertise will be called upon for material selection and qualification for the Smart Container panels and for appropriate encapsulation systems to protect RFID electronics. Bayer will also advise us on the manufacturing process and materials used to construct the prototype of the Smart Container.



LANXESS, previously part of Bayer, has patented expertise in Plastic/Metal Hybrid technology. Inteligistics expects to investigate the use of this technology in the construction of structural members for the Smart Cabinet frame and Futuristic 5QuadPod. As a technology adviser, LANXESS

can provide Inteligistics with initial design assistance and advise Inteligistics regarding the material qualification and selection process. LANXESS also has the capability to conduct the simulation modeling and finite element analyses to confirm the design configuration. LANXESS is qualified to consult with Inteligistics on the manufacturing processes and to potentially supply Inteligistics with thermoplastic materials used to construct the prototypes as part of Phase II.



KEMA Powertest is an internationally renowned Independent Standards, Testing and Certification Laboratory. As a technology partner to Inteligistics, KEMA will prepare the standards for our flexible lightweight shipping systems, conduct the necessary test surveillance and provide certification of the systems during Phase II.



The Boeing Company is the Co-lead Systems Integrator for the Future Combat Systems (FCS) program. Boeing is interested in Inteligistics' RFID expertise, Dynamic Smart Box, Dynamic Smart Mainfest, futuristic 5quadPod Self-contained Modular Shipping Platform and Smart Cabinet for applications related to FCS and other in-house applications of our smart technology.



Mobile Aspects, Inc. is a sister company to Inteligistics, Inc. Inteligistics was formed to take the iRIS Supply Chain Management Cabinet System and related technology out of healthcare and into the commercial and industrial marketplace. Mobile Aspects technical staff works closely with the technical staff of Inteligistics.